CLEP®

Calculus: At a Glance

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CollegeBoard

Description of the Examination

The Calculus examination covers skills and concepts that are usually taught in a one-semester college course in calculus. The content of each examination is approximately 60 percent limits and differential calculus and 40 percent integral calculus. Algebraic, trigonometric, exponential, logarithmic and general functions are included. The exam is primarily concerned with an intuitive understanding of calculus and experience with its methods and applications. Knowledge of preparatory mathematics, including algebra, geometry, trigonometry and analytic geometry, is assumed.

The examination contains 46 questions, in two sections, to be answered in approximately 95 minutes.

- Section 1: approximately 28 questions, approximately 54 minutes. No calculator is allowed for this section.
- Section 2: approximately 18 questions, approximately 41 minutes. The use of an **online graphing calculator (non-CAS)** is allowed for this section. Only some of the questions will require the use of the calculator.

Graphing Calculator

A graphing calculator is integrated into the exam software, and it is available to students during Section 2 of the exam. Since only some of the questions in Section 2 actually require the calculator, students are expected to know how and when to make appropriate use of it. The graphing calculator, together with a brief tutorial, is available to students as a free download for a 90-day trial period.

Students are expected to download the calculator and become familiar with its functionality prior to taking the exam.

For more information about downloading the practice version of the graphing calculator, please visit the Calculus exam description on the CLEP website, clep.collegeboard.org/exam/calculus.

In order to answer some of the questions in Section 2 of the exam, students may be required to use the online graphing calculator in the following ways:

- Perform calculations (e.g., exponents, roots, trigonometric values, logarithms).
- Graph functions and analyze the graphs.
- Find zeros of functions.
- Find points of intersection of graphs of functions.
- Find minima/maxima of functions.
- Find numerical solutions to equations.
- Generate a table of values for a function.

Knowledge and Skills Required

Questions on the exam require candidates to demonstrate the following abilities:

- Solving routine problems involving the techniques of calculus (approximately 50 percent of the exam)
- Solving nonroutine problems involving an understanding of the concepts and applications of calculus (approximately 50 percent of the exam)

The subject matter of the Calculus exam is drawn from the following topics. The percentages next to the main topics indicate the approximate percentage of exam questions on that topic.

10% Limits

- Statement of properties, e.g., limit of a constant, sum, product or quotient
- Limit calculations, including limits involving infinity, e.g.,

$$\lim_{x\to 0}\frac{\sin x}{x}=1,\ \lim_{x\to 0}\frac{1}{x}\text{ is nonexistent, and }\lim_{x\to\infty}\frac{\sin x}{x}=0$$

- Continuity

50% Differential Calculus

The Derivative

- Definitions of the derivative

$$\text{e.g., } f'(a)=\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$$

$$\text{and } f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

- Derivatives of elementary functions
- Derivatives of sums, products and quotients (including tan x and cot x)
- Derivative of a composite function (chain rule), e.g., $\sin(ax+b)$, ae^{kx}, $\ln(kx)$
- Implicit differentiation
- Derivative of the inverse of a function (including arcsin x and arctan x)
- Higher order derivatives
- Corresponding characteristics of graphs of f, f' and f''
- Statement of the Mean Value Theorem; applications and graphical illustrations
- Relation between differentiability and continuity
- Use of L'Hospital's Rule (quotient and indeterminate forms)

Applications of the Derivative

- Slope of a curve at a point
- Tangent lines and linear approximation

- Curve sketching: increasing and decreasing functions; relative and absolute maximum and minimum points; concavity; points of inflection
- Extreme value problems
- Velocity and acceleration of a particle moving along a line
- Average and instantaneous rates of change
- Related rates of change

40% Integral Calculus

Antiderivatives and Techniques of Integration

- Concept of antiderivatives
- Basic integration formulas
- Integration by substitution (use of identities, change of variable)

Applications of Antiderivatives

- Distance and velocity from acceleration with initial conditions
- Solutions of $y' = ky$ and applications to growth and decay

The Definite Integral

- Definition of the definite integral as the limit of a sequence of Riemann sums and approximations of the definite integral using areas of rectangles
- Properties of the definite integral
- The Fundamental Theorem:

$$\frac{d}{dx}\int_a^x f(t)\,dt = f(x) \text{ and } \int_a^b F'(x)\,dx = F(b) - F(a)$$

Applications of the Definite Integral

- Average value of a function on an interval
- Area, including area between curves
- Other (e.g., accumulated change from a rate of change)

Study Resources

To prepare for the Calculus exam, you should study the contents of at least one introductory college-level calculus textbook, which you can find for sale online and in most college bookstores. You would do well to consult several textbooks, because the approaches to certain topics may vary. When selecting a textbook, check the table of contents against the Knowledge and Skills Required for this exam.

A recent survey conducted by CLEP found that the following textbooks are among those used by college faculty who teach the equivalent course. Most of these have companion websites with practice test questions and other study resources.

- Anton et al., *Calculus: Early Transcendentals Single Variable* (Wiley)
- Armstrong and Davis, *Brief Calculus* (Prentice Hall)
- Bear, *Understanding Calculus* (Wiley-IEEE)
- Best et al., *Calculus: Concepts and Calculators* (Venture)
- Cohen and Henle, *Calculus: The Language of Change* (Jones & Bartlett)
- Hallett et al., *Applied Calculus* (Wiley)
- Hass et al., *University Calculus, Part One* (Addison-Wesley)
- Krantz, *Calculus Demystified: A Self-Teaching Guide* (McGraw-Hill)
- Larson et al., *Calculus I: Early Transcendental Functions* (Brooks/Cole)
- Neill, *Teach Yourself Calculus* (McGraw-Hill)
- Rogawski, *Calculus* (W. H. Freeman)
- Salas et al., *Calculus: One Variable* (Wiley)
- Schmidt, *Life of Fred: Calculus* (Polka Dot)
- Smith and Minton, *Calculus, Single Variable: Early Transcendental Functions* (McGraw-Hill)
- Stewart, *Single Variable Calculus* (Brooks/Cole)

In addition, the following resources, compiled by the CLEP test development committee and staff members, may help you study for your exam. However, none of these sources are designed specifically to provide preparation for a CLEP exam. The College Board has no control over their content and cannot vouch for accuracy.

AP® Calculus: Challenging Concepts from Calculus AB & Calculus BC
edx.org/course/apr-calculus-challenging-concepts-davidson-next-calapccx-0

Note: some of the materials covered in this AP course are also examined by the CLEP Calculus exam. CLEP test takers may use this course as a study resource for the topics covered by the CLEP Calculus exam.

Preparing for the AP Calculus AB Exam
edx.org/course/preparing-ap-calculus-ab-exam-part-1-ricex-advcal-1x

Note: Some of the materials covered in this AP course are also examined by the CLEP Calculus exam. CLEP test takers may use this course as a study resource for the topics covered by the CLEP Calculus exam.

Calculus 1A: Differentiation
edx.org/course/calculus-1a-differentiation-mitx-18-01-1x" \l

Calculus 1B: Integration
edx.org/course/calculus-1b-integration-mitx-18-01-2x

Khan Academy Calculus: Calulus
khanacademy.org/math/calculus-home

Math Forum Math Tools, Drexel U
mathforum.org/mathtools/sitemap2/c/

Wolfram MathWorld
mathworld.wolfram.com/topics/Calculusand Analysis.html

HippoCampus Calculus
hippocampus.org/HippoCampus/Calculus & Advanced Math

Oregon State's Calculus course online
oregonstate.edu/instruct/mth251/cq/index.html

MIT
ocw.mit.edu/OcwWeb/web/courses/courses/index.htm#Mathematics

You can also find suggestions for exam preparation in Chapter IV of the *CLEP Official Study Guide*. In addition, many college faculty post their course materials on their schools' websites.

Sample Test Questions

The following sample questions do not appear on an actual CLEP examination. They are intended to give potential test-takers an indication of the format and difficulty level of the examination and to provide content for practice and review. For more sample questions and information about the test, see the *CLEP Official Study Guide*.

Section I

Directions: A calculator will not be available for questions in this section. Some questions will require you to select from among five choices. For these questions, select the BEST of the choices given. Some questions will require you to enter a numerical answer in the box provided.

1. $\lim_{x \to \pi^-} \dfrac{\ln x - \ln \pi}{x - \pi}$ is

(A) 0

(B) $\dfrac{1}{\pi}$

(C) $\ln|\pi|$

(D) $\dfrac{\ln \pi + 1}{\pi^2}$

(E) nonexistent

2. $\lim_{x \to 1} \dfrac{1 - x^2}{x^2 - x}$ is

(A) -2

(B) -1

(C) 0

(D) 2

(E) nonexistent

3. $\int \left(\sqrt{x} - \dfrac{5}{x} + e^x \right) dx =$

(A) $\dfrac{2}{3}x^{\frac{3}{2}} + \dfrac{5}{x^2} + e^x + C$

(B) $\dfrac{2}{3}x^{\frac{3}{2}} - 5\ln|x| + e^x + C$

(C) $x^{\frac{3}{2}} - 5 + \dfrac{1}{2}e^{2x} + C$

(D) $x^{\frac{3}{2}} + 5\ln|x| + 2e^{x^2} + C$

(E) $\dfrac{1}{2x^{\frac{1}{2}}} + \dfrac{5}{x^2} + e^x + C$

4. Let f be a differentiable function such that $f(1) = 10$ and $f'(x) = \sqrt{x^3 + 15}$. What is the approximation of $f(1.2)$ found by using the line tangent to the graph of f at $x = 1$?
   (A) 10.1
   (B) 10.2
   (C) 10.4
   (D) 10.8
   (E) 11.0

5. The function f is defined by $f(x) = \ln(\sin x + 1)$. What is the slope of the line tangent to the graph of f at $x = 0$?
   (A) $-\ln(\pi)$
   (B) $-\frac{1}{2}$
   (C) 0
   (D) 1
   (E) $\ln(\pi + 1)$

$$f(x) = \begin{cases} x^2 - 4 & \text{for } x < 3 \\ k\cos(\pi x) + 1 & \text{for } x \geq 3 \end{cases}$$

6. Let f be the piecewise function defined above, where k is a constant. For what value of k is f continuous at $x = 3$?

   $k =$ ☐

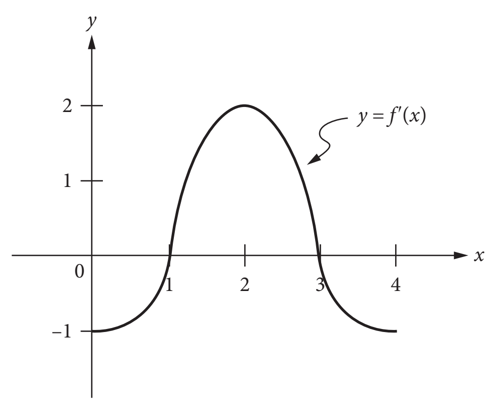
7. If $x^3 + xy = 0$, what is the value of $\frac{dy}{dx}$ at the point $(-1, -1)$?
   (A) −3
   (B) −1
   (C) 1
   (D) 2
   (E) 3

Section II

Directions: A calculator will be available for questions in this section. Some questions will require you to select from among five choices. For these questions, select the BEST of the choices given. If the exact numerical value of your answer is not one of the choices, select the choice that best approximates the value. Some questions will require you to enter a numerical answer in the box provide.

8. The curve $y = e^x$ and the line $y = 2x + 2$ intersect at two points in the xy-plane. Of the following, which is closest to the area of the region bounded by the curve and line?
   (A) −4.891
   (B) −1.286
   (C) 1.492
   (D) 2.227
   (E) 3.525

9. Oil is poured on a flat surface and spreads out, forming a circle. The area of the circle is increasing at a constant rate of 5 square centimeters per second. At what rate, in centimeters per second, is the radius increasing at the instant when the radius is 5 centimeters?
   (A) $\frac{1}{2\pi}$
   (B) $\frac{1}{\pi}$
   (C) 1
   (D) π
   (E) 2π



10. The graph of f', the derivative of the function f, is shown in the xy-plane above. Which of the following statements CANNOT be true?

(A) f is decreasing on $(0, 1)$.

(B) f is concave up on $(0, 1)$.

(C) f has a local maximum at $x = 3$.

(D) f has an absolute minimum at $x = 1$.

(E) f has an absolute maximum at $x = 2$.

Credit Recommendations

The American Council on Education has recommended that colleges grant 4 credits for a score of 50, which is equivalent to a course grade of C, on the CLEP Calculus exam. Each college, however, is responsible for setting its own policy. For candidates with satisfactory scores on the Calculus examination, colleges may grant credit toward fulfillment of a distribution requirement, or for a particular course that matches the exam in content. Check with your school to find out the score it requires for granting credit, the number of credit hours granted, and the course that can be bypassed with a passing score.

Answers to Sample Questions: (1) B; (2) A; (3) B; (4) D; (5) D; (6) −4; (7) D; (8) D; (9) A; (10) E.

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